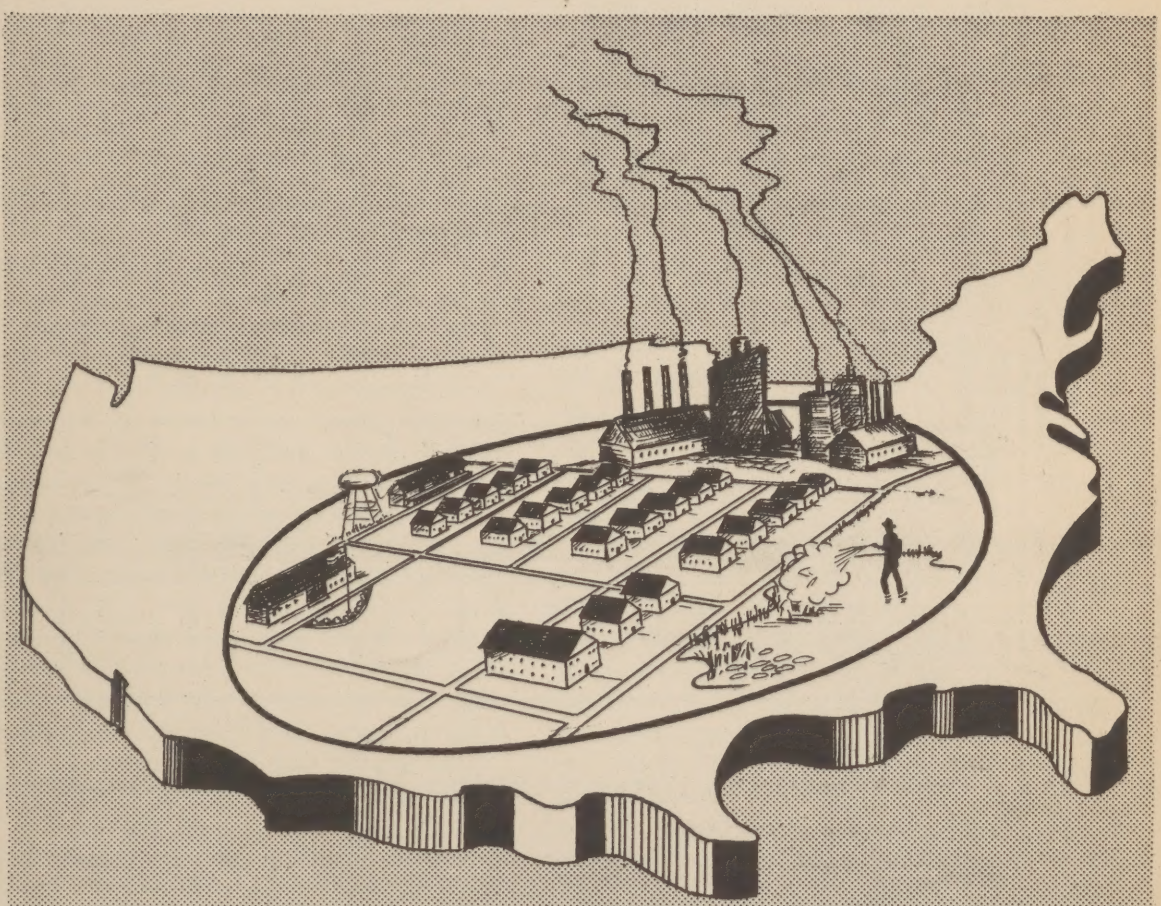
FIELD BULLETIN

IN-SERVICE TRAINING AND INFORMATION

MALARIA CONTROL IN WAR AREAS



ATLANTA, GEORGIA

OCTOBER, 1944

MALARIA CONTROL WITH THE YUNNAN-BURMA RAILWAY MEDICAL MISSION

ARTIFICIAL SHELTERS FOR MEASURING ANOPHELINE DENSITIES

FEDERAL SECURITY AGENCY — U.S. PUBLIC HEALTH SERVICE

TABLE I

MCWA LARVICIDE, MINOR & MAJOR DRAINAGE WORK

SEPTEMBER 1 - 30, 1944

STATE	Areas in Operation	War Establishments Protected	LARVICIDAL WORK				DRAINAGE OPERATIONS												Total Man Hours
			Larvicide Used		Surfaces Treated Acres		Clearing		Cleaning	New Ditching				Ditch Lining Placed		Underground Drainage	Fill	Water Surf. Eliminated	
			Oil Gals.	Paris Green Lbs.	Oiled	Dusted	Removal Surf.Veg. Acres	Stumping Grubbing Acres	Sq.Ft.	Hand	Lin.Ft. Mech.	Dynamite	Total Cu.Yds.	Lin.Ft.	Sq.Ft.	Lin.Ft.	Cu.Yds.	Acres	
Alabama	8	92	777	159	32	120	6.9	0.3	848,200	4,065	---	---	937	---	---	---	---	0.5	7,123
Arkansas	15	92	23,547	854	1,588	541	84.0	0.1	211,815	2,675	---	---	230	---	---	---	---	0.3	27,908
California	4	30	6,794	80	569	23	1.0	---	74,100	---	---	---	---	---	---	---	---	2.5	4,629
D.C.	1	22	---	---	---	---	0.3	---	---	50	---	---	16	---	---	---	---	---	1,060
Florida	18	113	10,734	2,435	720	1,305	38.3	1.2	1,317,216	23,665	---	---	1,839	---	---	---	4,507	14.3	34,887
Georgia	14	103	672	2,783	41	2,225	25.1	0.1	153,212	5,771	---	---	404	---	---	---	1,016	1.4	27,205
Illinois	2	54	4,194	391	156	377	0.3	---	---	200	---	---	23	---	---	---	---	---	3,157
Indiana	2	38	1,817	16	285	16	0.5	---	---	---	---	---	---	---	---	---	---	---	2,528
Kansas	1	20	925	---	41	---	---	---	1,400	600	---	---	66	---	---	---	---	---	898
Kentucky	5	48	2,902	71	179	60	10.1	0.1	20,005	4,552	---	---	159	---	---	---	---	---	7,719
Louisiana	8	86	78,792	---	3,948	---	45.5	0.1	846,152	13,957	---	---	1,626	---	---	---	160	11.3	62,729
Maryland	1	32	52	170	3	75	1.6	---	50,590	---	---	---	---	---	---	350	---	---	2,883
Massachusetts	--	4	552	85	49	66	---	---	---	---	---	---	---	---	---	---	---	---	709
Michigan	2	5	119	24	10	24	---	---	---	---	---	---	---	---	---	---	---	---	530
Mississippi	17	60	14,247	625	507	314	86.3	0.1	704,160	950	---	---	85	---	---	---	---	4.1	21,879
Missouri	7	22	5,190	622	594	328	2.4	---	22,645	---	---	---	---	---	---	---	---	---	6,710
New York	--	4	2,513	916	77	304	4.9	---	26,950	4,530	1,980	---	3,254	---	---	---	---	---	9,421
North Carolina	10	80	6,684	129	337	54	200.6	1.0	1,162,994	11,003	---	550	2,030	---	---	---	---	---	35,304
Oklahoma	9	62	15,337	250	971	207	10.7	---	8,229	1,545	---	---	51	---	---	---	---	0.3	14,590
Oregon	1	7	120	14	8	4	---	---	---	---	---	---	---	---	---	---	---	---	394
Puerto Rico	5	22	4,335	8,997	248	4,529	13.1	1.6	655,100	7,615	---	100	2,199	---	---	---	---	---	50,909
South Carolina	21	114	10,623	308	627	277	360.1	0.2	1,951,149	14,929	---	---	2,243	---	---	3,000	---	3.0	54,136
Tennessee	6	67	13,073	113	589	53	3.0	1.2	26,860	100	---	---	11	955	2,621	---	175	---	13,358
Texas	13	178	15,747	75	867	71	137.0	13.0	175,015	10,413	6,200	---	2,315	1,481	3,444	---	---	168.1	42,700
Utah	--	6	---	10	---	5	---	---	---	---	---	---	---	---	---	---	---	---	271
Virginia	4	93	8,249	1,491	292	280	14.4	2.5	62,116	7,040	---	---	599	---	---	---	---	---	20,621
Total	174	1,454	228,195	20,618	12,738	11,258	1,076.1	21.5	8,617,908	113,660	8,180	650	18,087	2,439	6,065	3,350	5,858	205.8	454,258
August Total	173	1,454	224,582	25,280	12,777	11,652	1,201.9	21.0	8,651,773	175,476	12,380	2,410	35,062	3,080	9,140	1,776	17,263	66.9	529,965

MALARIA CONTROL WITH THE YUNNAN-BURMA RAILWAY MEDICAL MISSION

By P. A. San. Engr. (R) L. B. Hall

In 1940-41, the Burma Road came into prominence because of its strategic importance in China's war with Japan. The Road connected the seaport of Rangoon on the South Asia coast with inland China, and provided the principal supply route into besieged China.

To supplement the limited Burma Road supply route, a railway was planned. Many obstacles were encountered. The route of the railway led through nearly unexplored jungle, over mountains as precipitous as any in the world, across two great rivers and hundreds of lesser streams. Laborers had to be transported hundreds of miles and rails, rollingstock and tools had to be brought from Europe or the United States.

Even more important than these mechanical difficulties were diseases which took a fearful toll and did more to hinder progress than any other factor. One of the worst of these diseases was "Chang shi", literally "bad air", or malaria. Although there was little specific knowledge of conditions along the route of the railway, malaria was found to be a serious problem along the Burma Road in 1939-40 by Williams, Mayne, and Bush and the Rockefeller Foundation had established a laboratory at Chefang, a few miles north of the Burma-China border in 1940. Studies by these two groups indicated a very high malaria rate along the Burma Road at elevations under 4000 feet and conditions were presumed to be as bad or worse along the proposed railway.

FORMATION OF THE MISSION

Anticipating trouble from malaria and other tropical diseases in constructing the railway, the Chinese Government requested aid of the United States. As a result of this appeal the Yunnan-Burma Railway Medical Mission was formed. Personnel consisted of two members of the Rockefeller Foundation and the following officers of the U. S. Public Health Service: Sr. Surg. (R) Victor H. Haas, Sr. San. Eng. (R) Henry A. Johnson, Sr. Surg. (R) Fred P. Manget, Sr. Surg. (R) Paul Stevenson, Sr. San. Eng. (R) Authur B. Morrill, Surg. (R) Thomas H. Tomlinson, Jr., P. A. San. Eng. (R) Lawrence B. Hall, P. A. San. Eng. (R) Fred W. Thomas, P. A. Ent. (R) Frank W. Fisk, P. A. Ent. (R) Gordon E. Smith, Asst. San. Eng. (R) Edward R. Lacy, Parasitologist William L. Jellison.

Members of the Mission travelled in groups of two and three via Pan-American Clipper plane from San Francisco to Honolulu, Midway, Wake, Guam, Manila and Singapore where British and Dutch flying boats picked them up for the one day flight over the green jungles and rubber plantations of the Malay States and Siam to Bangkok and Rangoon. A substantial portion of the Mission had reached Burma by December 7, 1941, but others were still in the United States and two were aboard a plane approaching Honolulu on the morning of the Japanese attack on Pearl Harbor. Those aboard the plane landed safely and subsequently returned to the mainland. These members and the balance of the Mission reached Burma early in 1942 after a long surface voyage to Africa and a flight across that continent and India.

PRELIMINARY ORGANIZATION

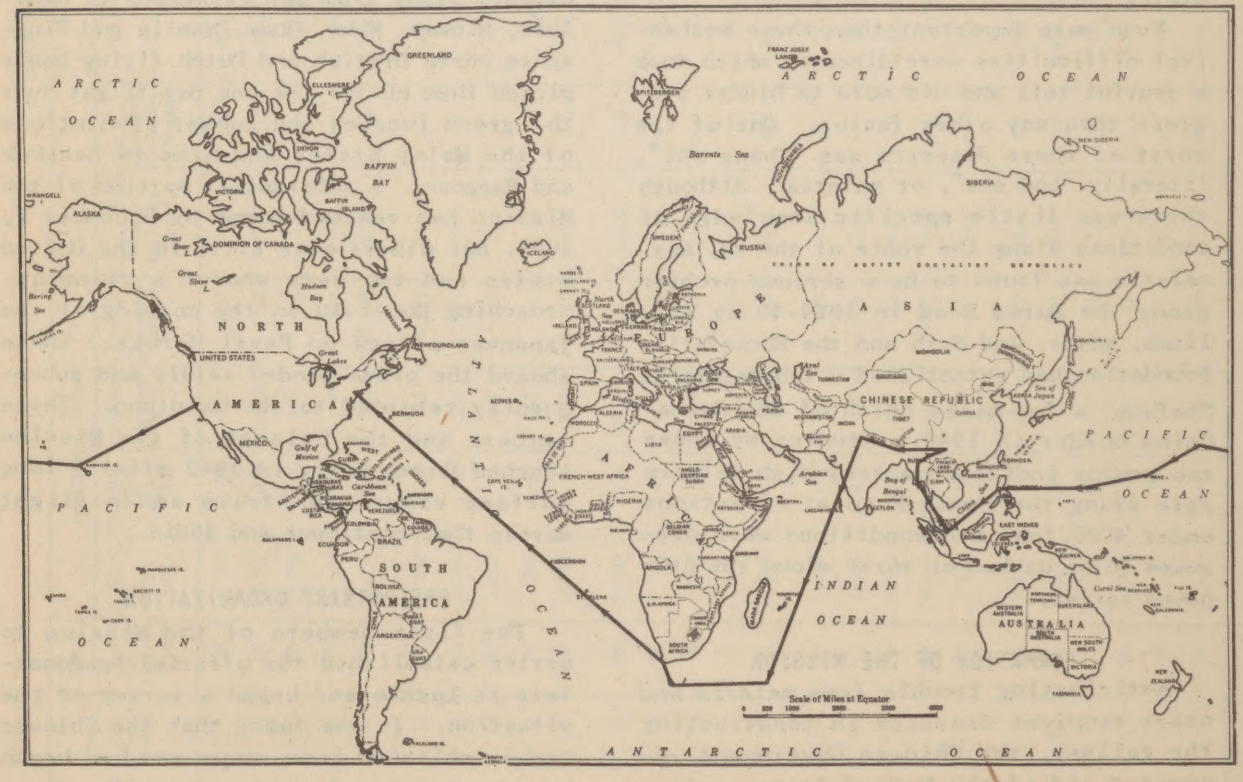
The first members of the Mission to arrive established the official headquarters in Lashio and began a survey of the situation. It was found that the Chinese had established base camps and had begun to cut access roads into the jungle. Hundreds of thousands of Chinese laborers

were scattered along the proposed right-of-way. The great majority of the labor consisted of levees, designated as "volunteer labor", the men being selected by the village officials. Those selected were mustered in, each given a sixty pound sack of rice to carry, and the group marched, for as many as 30 days to reach the site of their labors. On reaching the point at which they were to work they put up thatched lean-tos or found shelter in caves and hollow trees. Hospitals had been established, consisting of thatched bamboo huts with earthen floors and bamboo mats for beds. Inspection of the camps and right-of-way revealed that malaria and other diseases had already struck hard at the pioneer labor forces.

As soon as possible the members of the Mission scattered to points along the railway. Plans called for two engineers and an entomologist to be assigned to each district of approximately 140 miles. An epidemiologist and a medical officer serving as hospital supervisor were assigned to the entire right-of-way. To aid these

Chinese Laborers on the Railway

Public Health Service Officers, specially chosen Chinese doctors and nurses were assigned to the hospitals, and male secondary school graduates, after a short training course under Chinese instructors, were assigned as sanitary inspectors. These forces were dispersed as widely as possible along the railway but there were



Itinerary of Members of the Yunnan-Burma Railway Medical Mission

insufficient numbers for duty in any but the headquarters camps. Occasional trips were made along the railway between the main camps but the distances were too great and travel too difficult to permit adequate supervision of the sanitary inspectors stationed at the small camps.

Though the control of malaria was the main objective of the Mission it was at once apparent that general sanitation was absolutely necessary. Water supplies, in general, consisted of any convenient stream. Sewage and garbage fell where it might or was dumped into the same stream from which water was taken. A few improved water supplies were installed at the camps, well points being sunk to ground water. Hundreds of straddle-ditch latrines were dug, but the laborers had to be educated to their use. Graveyards were established at frequent intervals with deep graves always left open as an inducement to the laborers to bring their dead rather than abandon them at the side of the road.

THE MALARIA PROBLEM

Malaria proved to be a worse problem than was feared. Although the work was being carried on during the dry season, a high proportion of the laborers, sleeping through the hours of darkness in the open or at best in crude shelters, were repeatedly exposed to the bites of the vectors, *Anopheles minimus* Theobald, *fluviatilis* James, and *maculatus* Theobald, spreading malignant tertian malaria. Many of the cases were cerebral in character with very rapid progression of the disease, death often occurring in twenty-four hours or less when treatment was not obtained. Black water fever was prevalent and proper treatment difficult, even in the hospitals.

A rather large supply of quinine and atabrine was available for treatment of cases, but the use of drugs for suppression of malaria was not authorized.

Transportation was the taproot of trouble on the railway for not only was it hard to transport medicine to the remote camps, but food itself was very scarce. The countryside produced very little food so that almost all rice had to be brought

Chinese Doctor Dispensing Quinine

in from southern Burma. Huge dumps were established at the ends of the roads and from these the rice was carried on the backs of animals and humans to the remote points. The laborers in some areas received about half their normal diet of two

Pack Train Bearing 60 lb. Sacks of Rice

pounds of dry rice a day. This short ration plus, in many instances, the absence of salt, meat or vegetables resulted in severe malnutrition of considerable numbers of laborers and weakened the men to such a state that they were ready victims for malaria and other prevalent diseases.

Control of *Anopheles minimus* was obtained at the main camps but adequate materials and labor were never available for control along the entire right-of-way. A large supply of paris green was on hand and a few drums of oil. Not more than a half dozen hand dusters were ever available for the whole railway; therefore, hand distribution of the dust was necessary. Road dust, dried and pulverized on a sheet of corrugated steel over an open

Hand Distribution of Dust by Malaria Crew

fire, was mixed with paris green in a mixer contrived of sections of hollow bamboo. Carrying the mixture in buckets, the laborers of the malaria crews threw handfuls of the dust over the breeding places.

Anopheles minimus prefers seepage water for breeding. This type of water abounded in the area, particularly in the valleys followed by the railway, appearing mostly in pools along the edges of streams. However, breeding was found in everything from large swamps to animal tracks. Fortunately, *A. minimus* has an effective flight range of only one-half mile which made the area needing control relatively small.

EVACUATION TO INDIA

While some members of the Mission were working in the jungle, others were stationed at headquarters in Lashio where they were bombed regularly by the Japanese invading southern Burma. Early in 1943 Rangoon was captured and thus the seaport supplying China was cut off. To counter this loss, the Chinese moved a portion of the railway labor to northwestern Burma and began construction of the Ledo Road "to provide a new inlet" for the Burma Road. Two Public Health Service Officers

Convoy Enroute to Kunming

were assigned to this area where the malaria problem was much the same as in eastern Burma but where food was more plentiful and the general health of the population was much better. However, this work had been under way only a short time when the advancing Japanese forced the evacuation of Lashio and with it the evacuation of the headquarters of the Mission. Word of the situation reached the scattered officers by devious means and orders were issued for as many of the group as possible to rendezvous at the Rockefeller Foundation Laboratory at Chefang, China, on the Burma Road. Many of the group did meet at the laboratory after various adventures. From this point all of the trucks and cars still in the possession of the Mission were formed into convoys and the long trip toward the interior of China was begun. Sixteen days later, after traveling with an average of two hours sleep a night and undergoing several severe bombings, the convoy pulled into Kunming, more or less intact. There word was received that members of the Mission who had not reached the rendezvous at Chefang were walking to the Burma Road along the railway right-of-way. After a very short wait in China most of the officers were flown over the "Hump" into India where they were assigned to duty with the U. S. Army forces in the China-Burma-India theater.

ARTIFICIAL SHELTERS
for measuring anopheline densities

In areas where the usual type of natural resting place is not available, various types of artificial shelters have been devised in an effort to obtain reliable information on the density of *Anopheles* mosquitoes. In this country two types of artificial shelters are in use for this purpose, e.g. red boxes (Goodwin, 1942) in Georgia and nail kegs (Smith, 1942) in the Tennessee Valley Authority. More recently two additional types of shelters have been developed by Major S. J. Carpenter, in cooperation with other officers of the Fourth Service Command.

Pyramidal Shelter

Privy-type Shelters

Box-type Shelter

FOURTH SERVICE COMMAND SHELTERS

Pyramidal Shelter. A pyramidal shelter was used during 1943 by mosquito control workers at Myrtle Beach Army Air Field, South Carolina. This artificial shelter is approximately 6 feet high, 4 feet square at the base, and 1 foot square at the top. The front is open to a height of approximately 30 inches above the ground.

Privy-type Shelter. During 1943, mosquito control workers at Fort Bragg, North Carolina and Fort Benning, Georgia used an artificial resting station in the form of a small house 4 feet square and 7 feet high. In densely shaded areas all four sides are open for a distance of approximately 30 inches above the ground. For shelters located in partially shaded areas three sides can be closed, leaving an entrance on one side.

MCWA SHELTERS

P. A. San. (R) Herbert Schoof reports that privy-type shelters have proved to be very satisfactory in North Carolina and are now in use in many areas throughout the State. At the suggestion of San. (R) T. F. McNeel, similar shelters were employed with satisfactory results by Asst. San. (R) P. H. Harden in Louisiana.

Since artificial shelters are being used so extensively it should be pointed out that the type of shelter is not so important as the selection of a suitable location. Large shelters may be necessary in areas where no protective vegetation is available but, otherwise, large size is of no particular advantage. The purpose of such shelters is not to catch as many mosquitoes as possible. The ideal artificial shelter is one of moderate size which, when properly placed, attracts a sufficient number of "quads" to give a significant index of the fluctuations in population from day to day.

HEADQUARTERS NOTES

DR. FREEBORN LEAVES THE SERVICE

Early in October Sr. Malariologist (R) S. B. Freeborn, in charge, Division of Operations, left the Service to return to his administrative duties with the University of California College of Agriculture. Dr. Freeborn played an important part in shaping the destinies of MCWA. His knowledge of all phases of malaria control helped us over many a difficult spot and his personal influence reached throughout the program and endeared him to all those with whom he came in contact. The policy functions of the Division of Operations have now been transferred to the Executive Office and the other activities of the Division have been assigned to the three operating units formerly under the Division of Operations.

EXTENDED MALARIA CONTROL

State and District MCWA personnel from the most malarious Southeastern States met in Atlanta from Oct. 24 to 26 to lay plans for winter work and to discuss ways and means of effectively meeting the impact of returning malaria carriers.

A proposal has been submitted covering extension of the present malaria control program into civilian areas where malaria is significantly endemic. It is felt that the problem of returning carriers can be met by concentrated work in those areas where malaria still flourishes and where the introduction of additional carriers would further aggravate the situation. The proposal calls for larviciding and some drainage around urban areas and residual spray treatment in rural areas where the population is more scattered. Work would begin January 1st, 1945 in the 68 most malarious counties, with important portions of other counties receiving attention in accordance with available epidemiological evidence.

FIELD INVESTIGATIONS IN PUERTO RICO

The effectiveness of DDT in malaria control is being investigated in Puerto Rico in cooperation with the Insular Health Department and the PHS District office. Two villages have been selected and surveyed to determine the parasitemia rates. One village is now being treated with DDT as a residual spray in an attempt to kill infected adult mosquitoes. The other village remains as a check. This is a severe test of the effectiveness of DDT and should do much to crystallize our plans for malaria control in this country.

Officers assigned to this project include P. A. Eng. (R) G. R. Christensen and P. A. San. (R) R. E. Serfling as well as P. A. San. (R) C. M. Tarzwell from the Savannah MCWA laboratory and Surg. V. P. Link, from the MCWA Headquarters office.

CHANGES IN APPOINTMENT PROCEDURE

The Administrative Division has succeeded in reducing to an absolute minimum, the number of appointment forms required to be completed at the area level.

PROFESSIONAL PERSONNEL

Asst. San. (R) Geoffrey M. Jeffery was commissioned during October and assigned to cooperative work with the Tennessee Valley Authority at Wilson Dam, Alabama. Transfers include Asst. San. (R) Gordon W. Ludwig from Norfolk, Va., to headquarters, where he will replace P. A. San. Eng. (R) Ralph C. Palange (recently assigned to UNRRA) in charge of the Equipment Unit; P. A. Surg. Penno K. Milmore from headquarters to a Navy assignment; Asst. San. (R) J. H. Allison from Lake City, Fla., to the Santee-Cooper project; Asst. San. (R) Robert Samuels from New Orleans to Santee-Cooper; Asst. San. (R) W. C. Baker from New York to the Savannah MCWA Laboratory; Asst. San. (R) Fred C. Harmston from Indianapolis, Ind. to Salt Lake City, Utah; Asst. San. (R) J. K. Neel from Paducah, Ky. to Montgomery, Ala.; Adm. Asst. L. A. Arel from headquarters to Little Rock, Ark.; Adm. Asst. Clifford Carr, Jr. from Little Rock to headquarters; and Asst. Eng. (R) K. E. Hanus from the Savannah *aegypti* project to the Charleston project.

New assignments include Asst. Eng. (R) G. L. Jacobson to Marysville, Calif.; and Jr. Public Health Engineers L. O. Leslie and R. G. Hastings to Jackson, Mississippi.

DIVISION NOTES

MEDICAL DIVISION

Surgeon V. B. Link returned on October 20 from Puerto Rico where he served as an observer and consultant on the medical aspects of field malaria control investigations. Dr. Link reports that this is a year of relatively low prevalence of malaria in Puerto Rico.

ENTOMOLOGY DIVISION

A paper was prepared for presentation at the National Malaria Society meeting showing length of season and maximum populations of *Anopheles quadrimaculatus* for successive 5° isothermal zones of the Southeastern United States.

ENGINEERING DIVISION

Criteria have now been established for guiding control operations during the coming winter season. Regular MCWA work which is recommended falls into three main categories: conditioning for larviciding, drainage repairs, and drainage (including permanent drainage).

Conditioning includes work required because of (a) ineffectiveness of previous larviciding, and work required (b) to convert from hand to mechanized larviciding, (c) to eliminate breeding semi-permanently, (d) to convert project operations from control by full time resident control crews to surveillance, or (e) to reduce future larvicidal costs. Drainage repairs include not only reconditioning of ditches but the installation or repair of appurtenant and special structures in drainageways to prevent impending failure or reduce excessive maintenance costs. These comprise such items as checks, aprons, spillways, headwalls and wingwalls. Sodding of existing ditches is also a repair item but this can be performed best in the spring.

Permanent drainage is defined as those items of work beyond the construction of plain earth ditches which effectively combat destructive forces in drainageways or prevent malaria mosquito breeding in ditches. Destructive forces include (1) siltation, (2) erosion of ditch sections from storm water, (3) erosion of banks from seepage or bank wash, and (4) damage by man and animals.

Drainage work considered justifiable during the winter period comprises (1) continuation of the limited remaining amount of Class A MCWA temporary drainage where permanent drainage is not undertaken, (2) permanent drainage around permanent military establishments, and (3) permanent drainage around permanent urban areas in war establishment counties.

Activities which should not be carried on include: (1) Class B drainage construction around temporary military establishments, (2) cleaning and reconditioning of ditches in which "quad" breeding did not occur during previous seasons, (3) removing sand and silt from ditches which will become resilted before the next season, (4) clearing and cleaning of light vegetation from ditches, ponds and shorelines where complete regrowth may be expected to occur before or at the onset of the next season, (5) larviciding during the months of November through March. In general, work should not be undertaken this winter which will not significantly lower "quad" breeding during the 1945 season.

AEDES AEGYPTI DIVISION

Aedes aegypti control projects are being closely integrated with the general sanitation programs of local health departments. This is a natural step now that the work is well established and has proved itself. It is felt that cooperative effort at this time will strengthen local sanitation programs, make possible the coverage of more areas that need protection, and contribute something of permanent value to those cities in which we are working.

TRAINING DIVISION

Three MCWA officers completed the In-service Orientation and Training Course during October. In addition, Eng. (R) Granville W. Woodson completed the course as partial preparation for duty with a PHS commission destined for duty in Liberia.

LITERATURE REVIEW

The Journal of the National Malaria Society, Volume III, Number 3, Sept. 1944.

The latest number of the Journal of the National Malaria Society contains six articles on diverse phases of malaria control. Four of the six papers report on work of the Tennessee Valley Authority.

Boyd, M. F. *On the Parasite Density Prevailing at Certain Periods in Vivax Malaria Infections.*

Dr. Boyd gives "an analysis of the parasite density prevailing during the course of naturally induced vivax malaria infections in 307 adult white patients."

Rozeboom, L. E., and A. D. Hess. *The Relation of the Intersection Line to the Production of Anopheles quadrimaculatus.*

The "intersection line" has been defined by Hess and Hall (1943) as "the line of intersection between three interfaces, water-air, water-plant, and plant-air." In the present study "quad" production was determined for five different ecological types: (1) submerged, (2) grass-like, (3) leafy-emergent, (4) naked emergent, and (5) floating-leaved. A close positive correlation was found between the production of "quads" and the amount of intersection line per unit of water surface area.

Hess, A. D. and C. C. Kiker. *Water Level Management for Malaria Control on Impounded Waters.*

The schedule of water level management on reservoirs of the TVA consists of four phases: (1) spring flood surcharge, (2) maintenance of constant pool level during the spring growth period, (3) cyclical fluctuation, and (4) seasonal recession combined with cyclical fluctuation. The first two phases are purely prophylactic in that they limit or prevent the development of suitable breeding conditions for *Anopheles quadrimaculatus* later in the season by stranding flotage and limiting the invasion of marginal plants. The third and fourth phases are both prophylactic and curative in that they limit the invasion of marginal plants and also act directly against the mosquitoes by altering their microhabitat, exposing the larvae to natural enemies, and stranding eggs and larvae.

Kruse, C. W., A. D. Hess, and R. L. Metcalf. *Airplane Dusting for the Control of Anopheles quadrimaculatus on Impounded Waters.*

Dusting is carried out on TVA during the calm period of early morning, and the flying height is usually 20 to 30 feet. The dust distribution curve is noticeably skewed to the left, probably due to the torque of the plane propellor. It appears that about 20 per cent of the paris green released falls in the central 100 ft. of the dusting swath and another 8 per cent falls in the second 100 ft.; the remainder of the dust drifts away from the treatment area and for practical purposes may be considered lost. A chart is presented which shows effective swath widths of 70 per cent and 90 per cent larval kills under varying conditions of plant cover, rates of discharge, and distances between swaths.

Bishop, E. L. and F. E. Gartrell. *Permanent Works for the Control of Anophelines on Impounded Waters.*

The program for permanent malaria control in the last and largest TVA impoundment, the Kentucky Reservoir, will cover some 14,000 acres or 70% of the total 20,000 acres of potential marginal mosquito breeding surface.

The net capital investment amounts to an annual saving of some $168,000 or 50% of the amount that would have been required for a conventional program of larvicidal control with shoreline maintenance.

Rector, N. H. *Selection of Anti-mosquito Methods to Fit Specific Malaria Control Programs.*

Specific anti-mosquito methods generally employed are discussed under the following headings: (1) mosquito proofing of houses, (2) application of larvicides to destroy the aquatic stages, (3) permanent elimination of breeding places by draining or filling, (4) naturalistic methods of control, (5) spray killing of mosquitoes in dwellings and outbuildings, and (6) community education.

TABLE II

MCWA EXPENDITURES AND LIQUIDATIONS BY MAJOR ITEMS

SEPTEMBER 1944

	Continental U. S.	Percentage of Total	Puerto Rico	Percentage of Total
.01 Personal Services	$ 438,970.87	86.80	18,922.65	86.05
.02 Travel	22,625.43	4.47	5.77	.03
.03 Transportation of Things	3,794.53	.75	7.35	.03
.04 Communication Services	1,016.87	.20	----	----
.05 Rents and Utilities	2,161.76	.43	----	----
.06 Printing and Binding	817.87	.16	----	----
.07 Other Contractual Services	3,805.31	.75	----	----
.08 Supplies and Materials	26,986.92	5.35	3,053.57	13.89
.09 Equipment	5,494.96	1.09	----	----
Total	$ 505,674.52	100.00	21,989.34	100.00
Expenses other than Personal Services	66,703.65	13.20	3,066.69	13.95

TABLE III

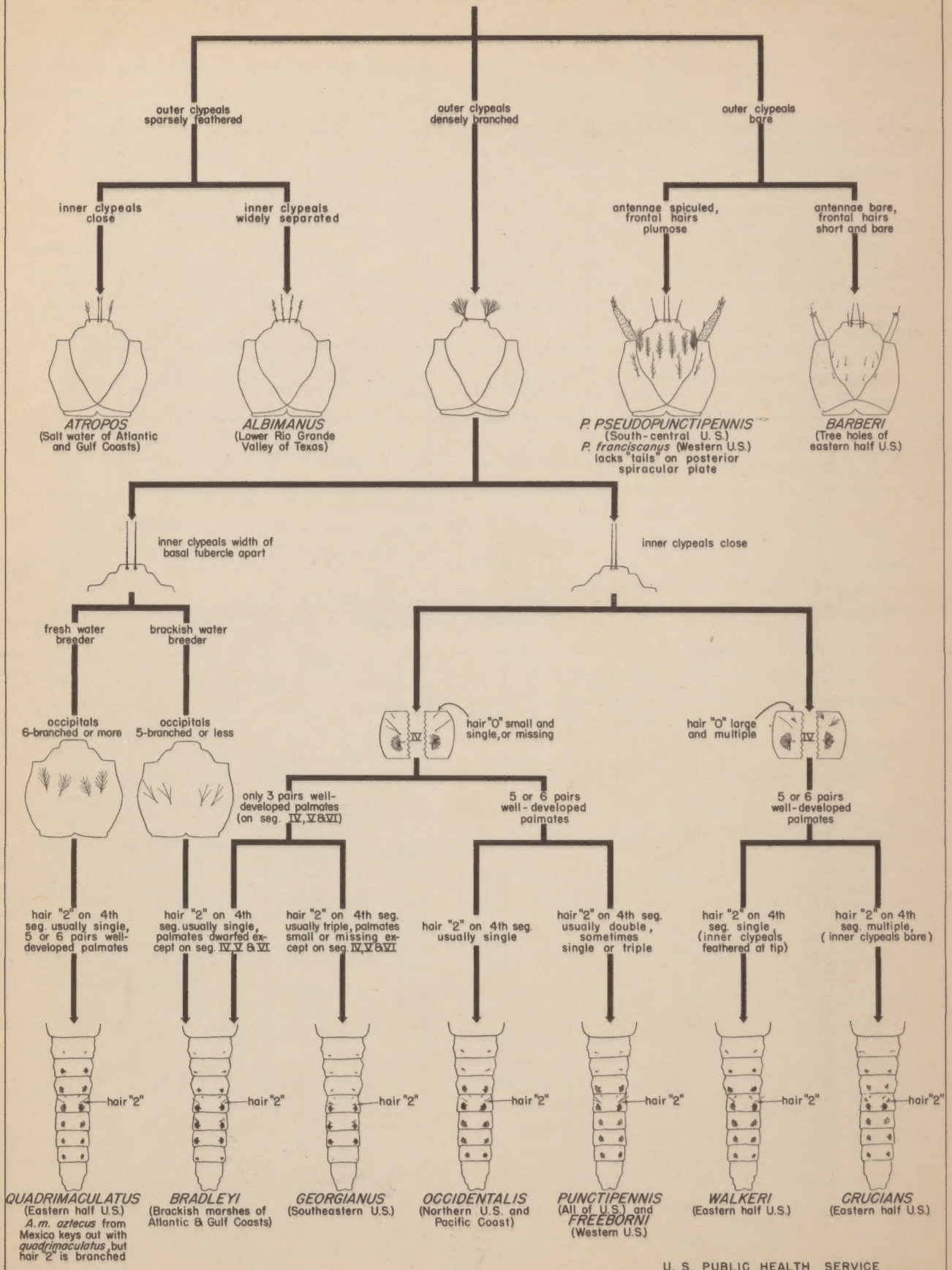
MCWA PERSONNEL ON DUTY AND TOTAL PAYROLL

SEPTEMBER 1944

State	Commissioned		Prof. & Sci.		Sub-Prof. (1)		C. A. F.		Custodial and Per Hour		Total		Percent of Total	
	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay
Alabama	3	1,024	1	264	3	468	2	428	31	4,242	40	6,426	1.31	1.42
Arkansas	8	2,420	8	2,152	30	5,727	5	758	136	17,173	187	28,230	6.14	6.23
California	3	851	---	---	6	1,254	3	622	23	3,762	35	6,489	1.15	1.43
Dist. of Columbia	1	332	---	---	3	554	1	233	3	405	8	1,524	.26	.34
Florida	7	1,991	4	1,330	19	2,939	6	2,250	183	22,828	219	31,238	7.19	6.90
Georgia	8	2,354	2	629	39	7,547	6	987	100	12,524	155	24,041	5.09	5.31
Illinois	6	1,691	1	203	1	49	3	562	13	1,818	24	4,323	.79	.95
Indiana	2	567	---	---	2	365	---	---	12	1,575	16	2,507	.53	.55
Kentucky	4	1,193	2	537	9	1,925	2	310	27	3,424	44	7,389	1.44	1.63
Louisiana	11	3,350	4	1,221	47	9,229	6	1,070	286	39,273	354	54,143	11.62	11.95
Maryland	2	531	---	---	3	543	2	438	12	1,640	19	3,152	.62	.70
Mississippi	4	1,797	3	801	12	1,446	4	1,456	91	12,022	114	17,522	3.74	3.87
Missouri	4	1,328	---	---	12	2,660	4	744	24	3,181	44	7,913	1.44	1.75
North Carolina	6	1,799	4	1,598	7	1,816	4	690	153	22,208	174	28,111	5.71	6.21
Oklahoma	5	1,493	1	264	12	2,701	1	146	52	7,316	71	11,920	2.33	2.63
Oregon	---	---	1	263	1	203	---	---	---	---	2	466	.07	.10
Puerto Rico	9	2,981	1	297	4	757	5	1,066	313	13,822	332	18,923	10.90	4.18
South Carolina	6	1,594	4	1,405	25	5,509	3	463	264	32,748	302	41,719	9.91	9.21
Tennessee	4	1,134	3	841	5	1,247	3	584	57	7,220	72	11,026	2.36	2.43
Texas	6	1,994	4	1,453	27	5,921	5	985	204	26,108	246	36,461	8.07	8.05
Virginia	3	929	2	696	12	2,991	3	602	109	15,241	129	20,459	4.23	4.52
AEDES AEGYPTI														
Alabama	1	284	---	---	8	1,431	1	146	---	---	10	1,861	.33	.41
Florida	1	284	1	273	38	6,707	2	292	---	---	42	7,556	1.38	1.67
Georgia	1	284	---	---	3	1,598	---	---	---	---	4	1,882	.13	.42
Louisiana	1	284	1	264	16	3,110	1	164	1	125	20	3,947	.66	.87
South Carolina	1	208	---	---	10	1,936	1	82	1	218	13	2,444	.43	.54
Texas	5	1,387	1	94	33	5,251	2	310	4	387	45	7,429	1.48	1.64
Hq. & Dist. (2)	74	23,822	14	2,788	54	8,976	124	20,887	28	3,259	294	59,727	9.64	13.19
Mobile Units	4	1,103	---	---	5	817	---	---	23	2,145	32	4,065	1.05	.90
Total	190	58,909	62	17,368	446	85,677	199	36,275	2,150	254,664	3,047	452,893	100.00	100.00
Percent of Total	6.23	13.01	2.03	3.83	14.64	18.92	6.54	8.01	70.56	56.23	100.00	100.00		

(1) Includes Entomological Inspectors
(2) Includes Headquarters and District Offices, malaria survey, Imported malaria control. special investigations, and employees temporarily attached to Headquarters pending assignment to states.

PICTORIAL KEY TO ANOPHELINE LARVAE OF UNITED STATES



NOVEMBER 1944

Modified from Freeborn and Gerberg by H. Knutson

U. S. PUBLIC HEALTH SERVICE
OFFICE OF MALARIA CONTROL IN WAR AREAS
ATLANTA, GEORGIA